SOIL CONSERVATION

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CONTROL MEASURES MEET CHALLENGE OF HEAVY RAINS

Torrential spring rains dramatically spotlighted the value of erosion control in midwest and southwest. A round-up of field reports from a wide frontage firmly underscored all the forecasts that had been made as to the probable effectiveness of the coordinated program of the Soil Conservation Service in checking losses of soil and water. Dust Bowl measurements showed increased moisture storage, Corn Belt and Wheat Belt tabulations brought out greater detention of run-off—as a result of contour furrowing, strip cropping, terracing, grass-seeding, tree-planting and other measures.

H. H. Bennett, Chief of the Service, wired from Garland that erosion control practices on demonstration areas in eastern Texas proved 95 percent effective in withstanding the impact of heavy rains with respect to preventing soil losses. This performance was in sharp contrast to what happened on unprotected neighboring lands, where another tragic chapter was added to the record of erosion.

Grass Succeeds

On the erosion experiment station at Tyler, Texas, Mr. Bennett reviewed the results of a downpour which was record-breaking as to intensity. Here soil was swept away from a cotton field at the rate of 63 tons per acre, with 31 percent of the rainfall lost in immediate runoff, whereas under a shawl of grass in an adjoining field, soil held 100 percent, and the water runoff amounted to but 0.3 of 1 percent.

Out in Iowa, where nearly 7 inches of rain fell in 90 minutes, establishing a 50-year high mark, 12,000 unprotected acres gave up more than 2.5 inches of their best soil, according to R. E. Uhland, regional conservator.

He wrote:

Bridges were washed out, fences destroyed, livestock killed, and other property was severely damaged. Corn fields, plowed land and areas planted with grass mixtures this spring suffered the most damage. In many instances plowed fields, and particularly hillsides, were washed to the subsoil. Some bottomland pastures were buried beneath two feet of soil from untreated, cultivated fields nearby.

The land protected by erosion-control structures presented a sharp contrast. Terraced fields lost comparatively little soil because the water drained away slowly, leaving the soil in the fields where it belonged. Pastures and fields with cover crops lost

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SAVINGS-DEPOSITS OF MOISTURE

At time of going to press, the best available estimate indicated that more than **2,000,000 acres** in the five-State emergency area had been contour-listed previous to the rainy spell in May. This included operations in the demonstration projects.

Observations of moisture penetration showed that, roughly, **1 inch** of additional subsoil moisture was retained as a result of the contour practice.

The late report from H. H. Finnell, Regional Conservator, comments:

"This serves to wet the soil slightly more than **1 foot** deeper than was accomplished without contouring.

"According to determined water usage for this area. this is capable of adding, if efficiently utilized, **3,600,000 bushels** of grain to the normal production and approximately **500,000,000 pounds** of additional protective residue for the prevention of wind erosion next spring and winter.

"On the basis of recorded experiments, the surety of crop production has been increased about **75 percent.**"

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DR. BENNETT TALKS ON FLOOD CONTROL

That the most effective form of flood levee is a blotterlike vegetative covering of farm lands was maintained in an address by H. H. Bennett, Chief of the Soil Conservation Service, before the annual meeting of the New York State Society of Professional Engineers, May 23rd.

Paying tribute to the intelligence and efficiency of the engineering fraternity in its long single-handed fight to protect life and property from the periodical threat of high waters, the speaker brought to his audience a conviction that erosion can be controlled at its source and the task of disciplining unruly streams of the Nation thus made easier.

His words were particularly timely and effective because they were projected against the sounding board of Pittsburgh's and Johnstown's recent tragedies and to the accompaniment of torrential rainstorms and current floods in many scattered sections of the country.

Mr. Bennett's message follows:

Seeking Permanent Solution

As some of you may know, I entertain and have expressed, from time to time, some pretty definite ideas about flood control. As engineers, you gentlemen entertain some pretty definite ideas of your own. Some of you may not agree with me; I, in turn, may disagree with some of you. But the mere fact that you are willing to devote a part of your time during this meeting to the subject of soil erosion control, seems to indicate that we are rapidly getting together. When we do, I am confident that we shall all be a great deal nearer a permanent solution of the flood-control problem.

In the past, our approach to that solution has been highly specialized. The whole difficult problem of flood control has been turned over to the engineering profession because it has been regarded almost entirely as a matter involving the design and construction of down-stream levees, spillways, revetments, and dams. Within the limitations of available funds, the profession has met the responsibility thus placed upon it with a remarkable degree of success in harnessing the channelways of major streams.

Agriculture a Partner

But now, it seems to me the flood-control picture is changing. We in the field of soil conservation feel that we have a very definite and important contribution to make in controlling floods. The evidence accumulated during the relatively few years since this country began to consider soil erosion a matter of major concern leads me to the conviction that the problem of flood control requires action not only by the engineer, but by the agriculturist as well.

Don't misunderstand me. I question neither the importance of the engineer in the field of flood control nor the value of his work. On the contrary, I believe that this nation cannot afford to curtail the construction or hamper the progressive design of engineering works for flood control. Such works are essential.

Getting at the Source

But are they alone sufficient from the standpoint of maximum effectiveness? I do not think so. Levees, spillways, and revetments are downstream fortifications at the point of greatest danger, where flooded rivers bulge from their banks to devastate lands, crops and property. What of the point of origin of flood waters? Is it possible to cope with floods only after our rivers have become raging and destructive torrents? Or can we tackle the problem at its source—on the sloping lands of watersheds, where flood waters accumulate and silt loads are picked up? I am convinced that we can.

After all, flood waters start as rainwater and melting snow. Floods are made up of raindrops, infinitely multiplied. If we force them to move slowly and evenly into drainage-ways, it seems logical to expect a decrease in the volume and velocity of water poured into our trunk rivers by their tributaries.

Soil Fills Channels

Soil stripped from our fields—millions of tons of it a year—is dumped into waterways, shoaling channels, clogging reservoirs, or continuing on to the oceans. Huge deposits of erosional debris must certainly diminish the carrying capacity of numerous water courses, large and small.

Even more important, both as a flood hazard and as a cause of soil erosion, is the denudation of sloping lands. Vegetation retards runoff water, binds the soil in place against the wash of rain and the drifting of wind, and preserves the top layer of productive and absorbent soil. Without this absorptive and productive topsoil layer, land sheds water at an astonishing rate. Moreover, the millions of gullies—man-induced waterways that usually form after the surface soil has been stripped off—discharge runoff water into neighboring streams with maximum speed.

Example of Absorption

As an illustration, consider what happens when a pitcher of water is spilled on the surface of a tilted wooden table. The water rushes off immediately and forms a puddle on the floor. But what happens if the hard wooden surface is covered with a blotter and then a heavy Turkish towel? Most of the water is absorbed; the excess is impeded and spread in its downward flow by the nap of the towel.

Studies at our erosion experiment stations in 13 major agricultural regions show very conclusively that the same thing happens in nature. The topsoil, humus-filled and made porous by the

burrowing of earthworms, insects, and the roots of plants, is highly absorptive—a blotter for rain. Vegetation, like the nap of the towel, forms countless tiny impediments to the downhill flow of rain water the soil is unable to absorb. But when vegetation and the topsoil are removed, rainwater rushes across the impervious subsoil surface about as rapidly as the water that rushed across the wooden surface of an inclined table. Even before erosion has proceeded to the point of subsoil exposure, vegetation and vegetative litter, functioning as a screen, serve to keep open the hidden conduits of the soil by preventing their clogging with eroded soil carried in suspension.

Research Yields Evidence

Let me give you quickly a few highly pertinent findings from representative erosion experiment stations. On an 8-percent slope in Missouri, land cropped continuously to corn has lost year after year an average of 28 percent of the total precipitation as immediate run-off. On another part of the same slope, planted to alfalfa, only 4.5 percent of the precipitation has been lost. Corn, as you know, is clean cultivated and covers only a fraction of the ground surface. Alfalfa, on the other hand, is close-growing and soil-binding and, covers all of the ground. Grass has exerted much the same restraining effect on run-off.

Soil losses accompanying these water losses have been at annual rates of 67 tons per acre from corn land, 0.28 tons from alfalfa fields, and 0.33 tons from grass. From bare soil (fallow, kept clean of all vegetation), the water loss has amounted to 29 percent of the total precipitation and the soil loss has been at the rate of 105 tons an acre.

Corn Versus Bluegrass

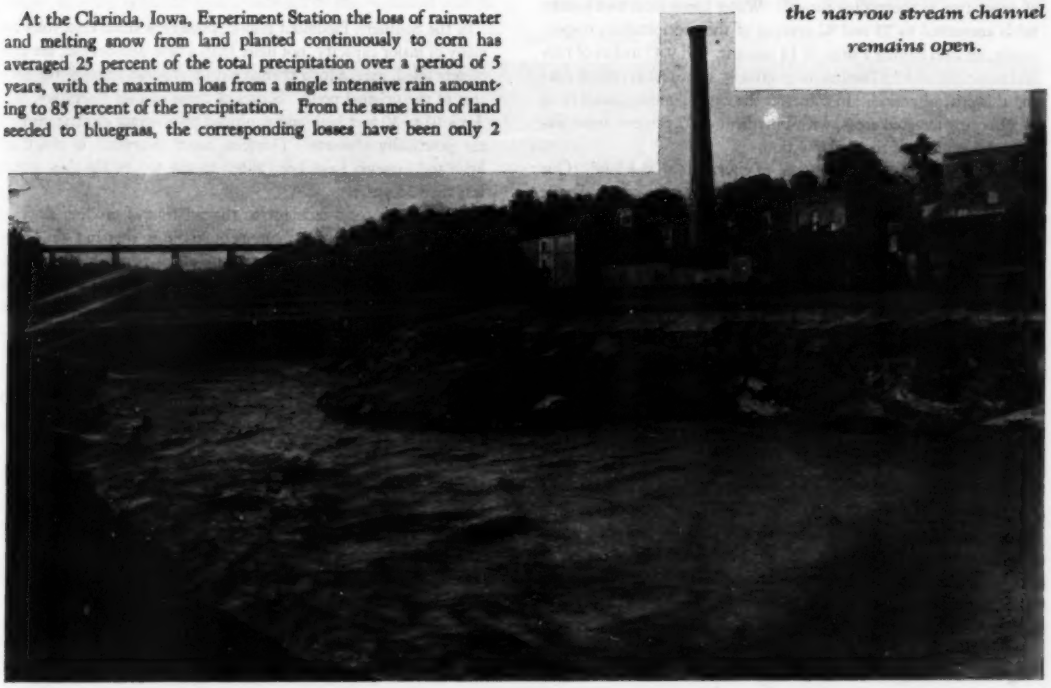
At the Clarinda, Iowa, Experiment Station the loss of rainwater and melting snow from land planted continuously to corn has averaged 25 percent of the total precipitation over a period of 5 years, with the maximum loss from a single intensive rain amounting to 85 percent of the precipitation. From the same kind of land seeded to bluegrass, the corresponding losses have been only 2 percent of all rains and 14 percent of the maximum from a single rain. It is interesting to observe that at the same station 100 percent of the precipitation from a single torrential rain ran off a cornfield having a slope of somewhat greater length than the other fields referred to.

I could cite similar examples from many parts of the country. Naturally, the rate of run-off varies from locality to locality because of variations in soil, character of rainfall, type of agriculture, and other factors. But our experiments have shown beyond any question that the run-off of rainwater is enormously reduced where the land retains its natural cover or a substitute. Measurements made on a large number of extensive and distinct types of agricultural soils have shown that, on the average, land covered with trees, grasses, legumes and similar close-growing crops absorb five times as much rainfall as the same kind of land planted to clean-tilled crops, such as corn, tobacco, and cotton. We cannot, of course, grow our crops in the woods or keep all our fields in grasses and legumes. But we can devote the steeper, more erodible slopes to forest, meadow, or permanent pasture, and protect our cultivated fields by strip cropping, rotating tilled crops with legumes and grass, growing winter cover crops, increasing the humus supply of the soil, terracing, contour tillage, and interrupted furrowing—all of which practices largely increase the absorption of both rainfall and melting snow.

Meadow Proves Superior

You will be interested, I believe, in a recent report by Dr. F. B. Howe, of Cornell University, on the relationship between erosion

Silt deposit in the Converse, S. C., reservoir. Only the narrow stream channel remains open.



Sheet erosion on field disked up and down slopes, near Guide Rock, Nebr.

and floods in New York City. Studies carried on near Ithaca, according to Dr. Howe, showed that a single acre of corn land lost as run-off 127,000 gallons, or 6.37 inches, more water during one growing season than an acre of comparable meadow land on another part of the same slope.

In an imaginary watershed of one million acres, planted entirely to corn, land of the same kind would, with the same precipitation, pour 134 billion gallons of water into drainage channels during the growing season. Run-off from the same area in meadow, would amount to only 7 billion gallons.

Potato Field Losses

Other measurements at the Ithaca erosion experiment station during the period from March 1 to 19, 1936, or just preceding the 1936 flood on that stream, are equally indicative of the effectiveness of vegetation in controlling run-off. Water losses from two potato fields amounted to 75 and 82 percent of the precipitation, respectively, on land having a slope of 14 percent. Of 9.47 inches of rain and snow, 7.1 and 7.85 inches, respectively, were lost as run-off during this critical period. In contrast, the corresponding losses from neighboring forested areas, with a gradient of 27 percent, were less than 0.5 percent of the precipitation.

The major damage from erosion, of course, is to the land. Our surveys indicate that approximately 50,000,000 acres of once-fertile land has been essentially ruined for practical cultivation. Another 50,000,000 acres is in a condition almost as serious. About 100,000,000 acres more, still largely in cultivation, has been seriously impoverished by the loss of topsoil; and on another 100,000,000 acres the depredations of erosion are getting actively under way.

Multiple Effects

But the effects of erosion do not end with the damage to the land. The soil washed from sloping fields and pastures—not less than three billion tons of it a year—is either poured into streams, reservoirs, harbors, and the oceans, or is deposited along lower slopes and over alluvial flood plains. Sometimes these deposits are beneficial to the land—more often they do great damage. Probably two-thirds of the vast load comes to rest in river channels, power and water supply developments, or is stranded elsewhere on its interrupted journey to tidewater. Scant attention has been given the matter of sedimentation. But recent studies indiate quite clearly that we shall have no permanent water-storage systems until we have curbed erosion along the headwaters of contributing streams.

For example, in 1925, Elk City, Oklahoma, constructed a water-supply reservoir costing over $325,000. Six years later, excessive silting made it necessary to raise the spillway two feet to provide adequate storage. In August 1933 engineers estimated that the reservoir had lost 48 percent of its original capacity because of silt. At the present time, the city is making plans for constructing a new reservoir because the impounded water is insufficient for municipal needs. The watershed that supplies water to this city is over 85 percent under cultivation.

As recently as 1930, the City of Waco, Texas, completed a storage reservoir. This reservoir has filled over 12 percent with silt, or at the approximate rate of 2½ percent a year. If this present rate of silting continues, the storage capacity will be entirely exhausted in another 35 years.

Damage in the Piedmont

In the Southern Piedmont region, numerous small reservoirs and many of major capacity, not more than a few decades old, are completely filled, except for a normal stream channel through the silted area of the original pond. Scores of these smaller reservoirs, with dams 10 to 30 feet high and equipped to generate electric current, are practically obsolete. Thirteen major reservoirs in the Carolinas and Georgia have been silted to the top of the dam within less than 36 years.

Let's return for a moment to the relation of eroding slopes to flood hazards. Recent measurements indicate that in a single year enough silt to form a prism one mile square and 164 feet high lodges in the channel of the Mississippi, between Cairo, Illinois, and Baton Rouge, Louisiana. Into the river every year go some 447 million cubic yards of soil material that erosion has taken from the land. Two-thirds of this enormous load is transported to the sea. One-third lodges in the channel and along the banks of the great stream. That can only mean, it seems to me, that the ability of the river to remain within its banks is being constantly diminished.

Flood Levels Rising

The record would seem to bear me out. Nine years ago the Mississippi rose out of its banks in the wildest rampage of which we have any record. Water rose to 45.8 feet on the gauge at Memphis—the highest mark ever registered there. The preceding highwater mark registered on the same gauge was 43.4 feet in 1916. Before that, the highest reading was 35.6 feet, back in 1890.[1]

[1] Floods in the United States, p. 320, Water-Supply Paper No. 771, U. S. Geological Survey, 1936.

Mississippi flood levels are rising, it appears, in spite of all we have done along that stream to hold floods in check. New records of flood heights were established along many waterways this year. Levees were thrown up over night at Washington in March in order to protect Government buildings, and they performed the service asked of them. Pittsburgh was less fortunate; the levees couldn't be built in time.

Levees 4,000 Years Ago

The Chinese call the Hwang Ho "China's sorrow." Four thousand years ago, the Chinese were building engineering works to hold this great river to its course. They built levees and canals, and excavated silting pools. But in 1878 it broke from its banks and drowned a million people.

The Chinese attempted to deal with floods just as we deal with them—at their point of greatest strength—and they failed. Northwestern China was once a vast expanse of forested highlands. The forests were cut down, and the steep slopes were brought into cultivation. Much of that area is now devastated, stripped of its topsoil by rainwash. Gullies have cut to depths of 600 feet. Millions of Chinese farmers have moved to the lower alluvial plains along the rivers, and concentrated there, a constant prey to the greater and more frequent floods that have resulted from removing the vegetative cover from the land. America has made the same mistake and continues to do so. But now that this error has been discovered, I believe we shall move forward on a new and more complete basis.

Chinese Go Forward

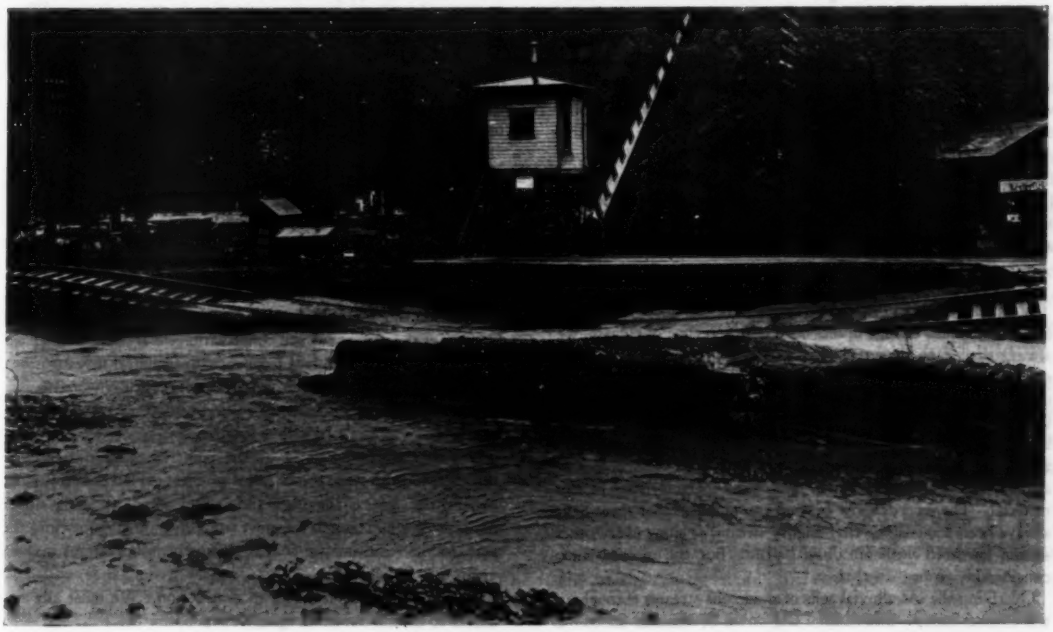
The Chinese appear, finally, to be thinking in this direction themselves: A letter received from a member of the technical staff of the National Geological Survey of China, written from Nanking April 24, 1936, has this to say about flood control in that country:

I have been greatly interested in soil erosion and its control, and also in the proper utilization of land. These problems are very acute in China and we are brought into close contact with them almost every day in connection with our work. . . . The flood control engineers . . . are talking of the necessity of watershed protection. We have the same difficulty here as in America—that of attacking the problem as a whole.

Aiding Nature

Soil conservation as practiced by farmers cooperating with the Soil Conservation Service in 41 States involves little more, fundamentally, than the use of nature's methods of erosion and flood control as I have outlined them. These farmers apply a coordinated plan of attack, utilizing many methods in which each distinctive piece of land is used and treated in accordance with its natural adaptabilities and economic needs. Instead of leaving fields smoothly worked over and bare, inviting erosion, the idea is to roughen the surface, turn the earth and the plants into impedi ments to runoff and protectors of the soil. By the simple device of plowing and cultivating around the hills, along the contour, instead of up and down the slopes, each furrow, each harrow scratch, becomes in effect a small dam or terrace. Reinforced by grass or other cover when the land is resting, with the steeper, more erosive slopes retired to forest or permanent grass, these measures, along with many others, stop a vast amount of water from running off into the streams. On the less stable slopes required for cropping purposes more elaborate methods are used. Here man must supplement the hand of nature with terraces, diversion ditches, and other measures. But the principle remains the

Railroad washout, Bath, N. Y., during high waters of July 1935.



Eroded field near Mankato, Kansas.

same—to make running water creep and, as it creeps, sink into the soil.

And I think you will agree that man cannot build a reservoir so huge and so effective as the soil itself.

Agriculture, to be sure, cannot offer you a substitute for flood water fortifications down the river. I am not in any sense proposing that. But agriculture can offer a multitude of reinforcements on the land where floods begin. When we shall have mutually agreed to a simple procedure of cooperation and coordination, it is my conviction that we shall then be moving in the right direction.

Nothing is to be gained, I feel, in devoting endless time to arguing our theories. Too much work is awaiting us—all of us—to waste precious time. But one point seems to need some clearing up. Occasionally someone questions the statement that the denudation of land contributes in any considerable degree to floods. In this connection we are frequently reminded that when De Soto first saw the Mississippi it was in flood—long before the ax or plow were known to America; and we are reminded again and again that we always have had floods.

Floods Inevitable

Well, I agree. Of course, we always have had floods; and until come cataclysmic change upsets our existing regime of climate, we always shall have them. Geologists will tell you that the whole mass of material forming the alluvial plain of the Mississippi was deposited and spread out by floodwaters through a process of slow land development—sedimentation—which had its beginning millions of years before De Soto discovered the river. The meandering of the Mississippi through its self-built plain since infinitely ancient time is recorded in the geological characteristics of this material. The records show beyond any question that there have always been floods along that mighty stream, as along every other stream bordered with an alluvial plain. But the records show considerably more than that.

Overlying the old alluvial soils of numerous streams throughout the United States—the material laid down by timeless floods—is a different kind of alluvium. It consists of sediments spread out by floodwaters since the beginning of our agriculture. Such deposits reveal unmistakable proof that, generally, they were spread over the flood-plains by waters much more violent than those which laid down the vastly older material beneath.

That the deposits of the pre-agricultural stage developed under moderate overflows is shown by their prevailing finer texture and more uniform composition. The line of separation between the two types of alluvium is so sharp that it is usually possible to photograph it without any difficulty. In many instances, the depth of the new material is greater than the entire depth of the older underlying deposit, and generally, it is not only coarser in texture, but far more diverse with respect to textural composition and color characteristics through the profile.

The Bureau of Chemistry and Soils is today mapping a number of new alluvial soils entirely different in character from those of pioneer days, now entirely buried. We have the history of these soils. We know denfitely that they have formed since the agricultural occupation of the country, and there is ample proof that these later deposits were laid down by more violently flowing waters than those of former times.

I mention this simply by way of assuring those who are skeptical of some of the things our soil conservationists are saying, that we are not separating ourselves from careful, technical investigations of the premises upon which we are basing our convictions, our plans, and our earnest desire to be understood, to help and to be helped.

We must start our attack at the point of cause and carry it through, step by step, to the point of effect. Flood control must begin at the crests of the ridges and extend down across the slopes to the stream, and then to the great trunk rivers that empty into the sea. In the meantime, of course, downstream operations may be vigorously prosecuted.

Erosion and floods are allies in destruction. We must ally our forces to defend ourselves against them both.

TWO BUREAUS JOIN FORCES ON SOILS PROBLEMS

Soil correlation problems of the Soil Conservation Service are the concern of a committee appointed under provisions of a supplemental memorandum of understanding with the Bureau of Chemistry and Soils. To this committee the Service will turn for correlation of all soil series and types identified and classified as part of the erosion map in conservation surveys, for advice as to the grouping of soil series and types as to erodibility, for assistance in the establishment of soil-type and soil-phase legends for approved survey projects, and for help in the grouping of soils on cooperative surveys with States preparatory to the publication of reports or maps.

Committee members are announced as Dr. Mark Baldwin, chairman; W. E. Hearn and T. D. Rice, for the Bureau of Chemistry and Soils; E. D. Fowler and A. E. Kocher, for the Soil Conservation Service. Alternates are the inspectors of the two agencies. The correlation and nomenclature of soil series and types become final when approved by the Chief of the Soil Survey Division.

Contact with the joint committee will be effected through the regular administrative channel, the Section of Conservation Surveys.

To Use Existing Facilities

The basic memorandum approved by the Secretary of Agriculture in January and the supplemental memorandum of April were born of an earnest desire to bring to bear on the erosion problem the experience, the accrued information, and the exceptional personnel of the older organization. It is also anticipated that the plan of cooperation will increase the use of soil survey reports and maps and will thereby multiply their value.

The basic memorandum clearly defines the responsibilities of the two Bureaus and designates meeting points for cooperative effort. It recognizes the Bureau of Chemistry and Soils as having sole jurisdiction over identification, classification, correlation, nomenclature, and mapping of soils, and charges it with the duty of publishing all soil maps. It recognizes the Soil Conservation Service as having full mandate for carrying on investigations and operations in erosion control, in connection with which it must make farm-by-farm surveys. The Soil Conservation Service is given the responsibility for making erosion surveys which show four factors, i. e., degree of erosion, percent of slope, type of soil, and present land use or cover. Cooperation with other federal and state agencies in the making of soil surveys is to be effected by the Bureau of Chemistry and Soils. In the making of erosion surveys and in connection with soil conservation projects, such cooperation will be by the Soil Conservation Service. Credit will be given for data obtained from either agency, upon its publication or release for publication by the other.

Detailed arrangements for soil and erosion surveys provide for the mutual exchange of information and for the detailing of certain personnel of the Bureau of Chemistry and Soils to the Soil Conservation Service.

Publication of Maps

As a result of the joint sifting of ideas and the definition of spheres of activity, soil conservation workers will have the twofold advantage of the present authentic and consistent soils maps (published by B. C. S.), and of erosion maps (published by S. C. S.) carrying degree of erosion and slope and cultural features, such as forests and grass cover.

CONTROL MEASURES

(Continued from p. 1)

practically no soil because the binding roots and vegetation prevented the water from concentrating in a channel where it could run off rapidly.

Ready for Rain

When late May rains broke the drought in the Southern High Plains, 1,916,910 contour-tilled and thirsty acres were in readiness to drink up the unaccustomed moisture and store it away for time of need. H. H. Finnell, regional conservator of Region 6, says that this readiness may prove the difference between a crop success and a crop failure and, in any case, will increase production and provide a cover better capable of resisting the winds of 1936 and 1937.

Engineers of the Soil Conservation Service ran many a contour line in the course of this broad-scale emergency-listing program and distributed 650,000 pounds of sorghum seed for use in providing cover crops on otherwise vulnerable lands.

Many farmers in the area have written to Mr. Finnell to tell of the bounty they have received from the water-conservation and soil-conservation measures

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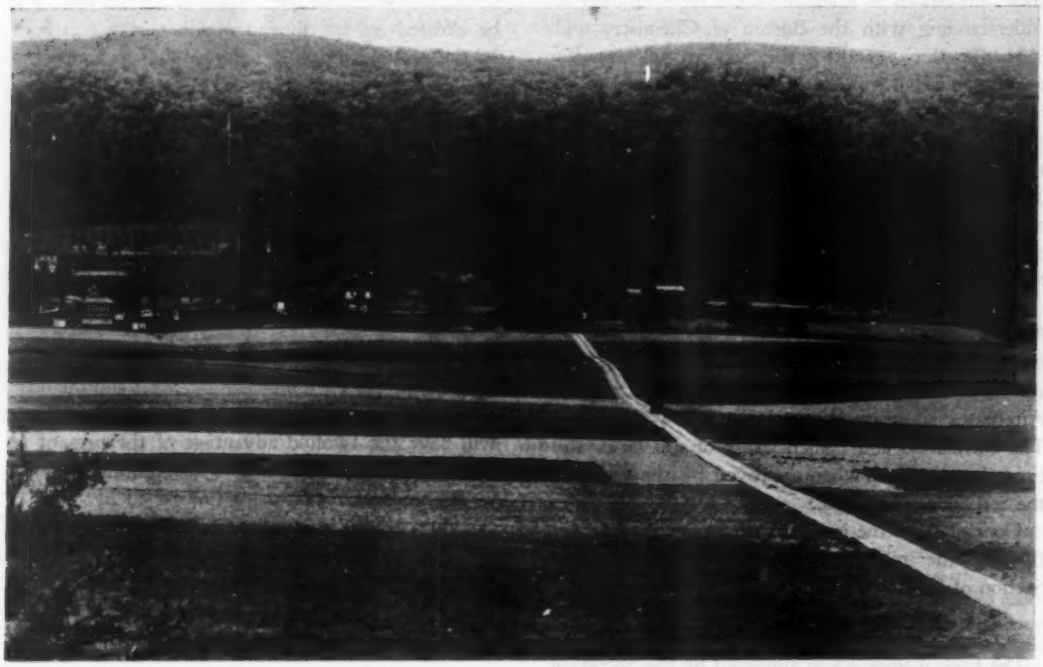
THE PLACE OF THE FORESTER IN SOIL CONSERVATION

By John F. Preston [1]



"The forester, by training and experience, has been thinking in terms of land values for one-third of a century. His philosophy of land use is that of the long look ahead; he deals in values which require decades to develop. The forester lays his plans with the thought that generations must elapse before his results properly can be evaluated and the economic conditions of the present are but a factor in the parade of the years. Land values have been as much a resource to him as the timber which demanded his special attention."—D. S. Jeffers in the Journal of Forestry, May 1935.

We have been wasting our soil through misuse for a very long time. Land which was once held in place by prairie grass or primeval forest has been cleared of the soil and water holding cover; it has been yielding its substance to agricultural crops which in turn have sustained our civilization during the years since the pioneer first broke ground for a wilderness farm. Not realizing that his methods were wrong, that the life-giving soil itself was being slowly but surely carried away by the rain upon which he depended to water his crops, the farmer has been pursuing his relentless course until disaster threatens both him and the nation which is dependent upon the soil. Dotted all over this country are abandoned farms, and thousands of others which are rapidly reaching the stage of abandonment. Worn-out soil cannot produce a profitable crop and cannot support the farmers.

Forest Reclaims Land

The sustaining power of the forest to hold the soil, the ability of nature to reclaim worn-out land by the reestablishment of trees, is proved by the forests which have grown to maturity on what was once cleared crop-land. All through the eastern states we can find the old stone fences in the midst of newly-grown forests, which marked the site of old fields. The corn rows can still be distinguished in the dense second growth forest. Wild apple trees, decendents of farmers' orchards, attest the power of the forest to

[1] The author is head of the Woodlands Section, Soil Conservation Service.

reclaim and hold the soil. In Vermont, Daniel Webster once made a speech to a great gathering of country folk. The land was cleared at that time, and there was plenty of room for the crowd. It was a gala day—the crowds milled about over a great expanse of country. Today that spot is far back in the wilderness. The land which was then farms was abandoned because the soil was worn out, and the forest again took possession.

Long-Time Thinking

It is not strange then, that the forester has been called in as one of the doctors to treat the sick farms. He is the master of the best means for soil conservation; he must be a big factor, for only a forest can reclaim the steep eroded lands cast off by the agriculturists. The training and experience of a forester make him peculiarly adaptable to soil conservation work. He has always been accustomed to land-use planning; the very nature of his work requires long-time thinking. He is accustomed to making maps; one of the chief things that he learns is how to put a square mile of land on a square inch of paper; he is a rough and ready surveyor; soils, slopes, contours, and ridges, are all familiar subjects. The forester is likely to prove more and more useful in the work of soil conservation.

Love for the Land

Soil conservation takes on more or less the character of a crusade. A most valuable and indispensable national resource is rapidly slipping away. The job is to convince the nation that something must be done about it. Here again foresters are experienced, for they have been through a forestry crusade to convince the nation that forests are essential to its well being, and I think we can safely say that the crusade has been successful. Such an undertaking requires imagination, vision, and above all a love for the land. The forester has proven that he has imagination; he also has vision—he could hardly be a forester without it. He must look a long time into the future, for his trees require oftentimes a century or more to grow. He is forced to look a long way ahead to the possibilities in a changing world. He also has a love for the land; he is an out-of-doors man; he loves the hills and streams; he has a sense of topography and he has been long familiar with the birds and

The part of the farm which is now in woods must be made to produce its share of the farm income.

Worn-out soil cannot produce a profitable annual crop; if planted to forest trees the soil will gradually be restored and an income from woodland obtained.

the beasts and the shrubs; the forester is in tune with the land; he is in sympathy with it; he appreciates its beauty, its fertility and its usefulness to man. He is more appreciative of these qualities than are the farmers themselves, because he is able to see the land in perspective. The forester is by training and by inherent characteristics fitted for the soil conservation job.

Chasing His Woodland

Just what is involved in the problem of soil conservation? Most of the farms in the eastern part of the country contain from 10 to 60 percent of their area in some kind of forest growth. Some of it is in land that was once cleared. Down South, the farmer has been chasing his woodland from one end of his farm to the other during the last hundred years. He clears the forest in one place while it springs up again on the fields abandoned, in another. Everywhere, he has cut it and culled it, and often almost ruined it for productive use by maltreatment. Grazing animals have trampled the young trees and packed the soil, and fires have been allowed to burn unchecked. The methods of cultivation have failed to hold the soil on many of the fields which in increasing numbers are cast aside for crop or pasture use and become "idle lands" capable of reclamation only by the forest.

The farmers' income now comes mostly from two-thirds to one-half, or even less, of his farm area, and that proportion through soil erosion is fast decreasing, and can be saved only by strip-cropping, by terracing, and other soil husbandry practices. The part of the farm which is now in woods or which must be planted to forest trees in order to save it, must be made to produce its share of the farm income.

The Forester's Task

That is the forester's task; it is his job to aid other farm specialists by making the forest pay its share. The farmer must use his forest not only for its soil-building and soil-healing properties on land worn out for crops, but he should get a cash income from it. The farmer has been accustomed to think of his woods as merely so much of his farm which cannot be farmed. True, he has drawn on it for years for his house logs,

(Continued on p. 14)

POINTERS ON GULLY CONTROL IN MIDDLE WEST

By Ray E. Penn[1]

1. Divert as much water as possible from gullies, being careful not to cause others.

2. The use of earthen dams and diversion ditches is more satisfactory in gully control in pastures. Such structures are essential in the control of alkali spots.

3. Use check dams only where they are necessary to handle water than can neither be diverted nor controlled by vegetation alone. Certain shrubs, forbs, and grasses may serve as check dams. Trees should be used with caution, and only solid plantings of them should be made.

4. Where check dams are used, they should be spaced at vertical intervals of not more than 30 inches with the weir of one about level with the base of the one above.

5. Where plantings or seedings are made or natural revegetation is expected, provide for keeping the velocity of the water low enough for such plants to grow.

6. Depend upon the plants that come in naturally, wherever such a course can be justified.

7. If plantings or seedings are imperative, select species that will thrive without heavy costs for seeding and fertilizing, and provide effective year-long cover.

8. Let nature build up the soil so that better plants can thrive.

9. Where seedings are made, use quick-growing plants like oats and rye that provide a cover quickly, to check erosion and to protect smaller and slower-growing plants, such as the perennial grasses.

10. Where sedimentation is likely to occur in the gully, use plants or seeds adapted to such conditions.

11. Plant legumes to gather nitrogen, which will aid the growth of grass.

12. Remember that gully soils are poor and will not support a dense stand, such as produced by heavy seeding. The tiny seedlings which must soon die are costly fertilizer.

13. Bank sloping is usually too expensive unless gullies can be used to advantage as parts of cultivated fields, or is necessary for the protection of other work.

14. If nature is left to do the bank sloping, protect the vegetation around the edge, and let it grow. It is best to plant grass such as Bermuda in the bottom of gullies.

15. Gullies on grazing land should usually be fenced unless it would be cheaper to stop grazing on the whole area until the gullies are healed over.

16. Keep out fire. The objective is the maximum of soil binding and water holding by vegetation dead or alive.

[1] Associate Range Examiner, Region 7.

CHIEF OF SERVICE RECEIVES DOCTOR OF LAWS DEGREE

Hugh Hammond Bennett on June 9 was awarded the honorary degree of Doctor of Laws by his alma mater, the University of North Carolina.

The recognition came as a result of Dr. Bennett's work as a writer, scientist, traveler, and explorer, and his contributions to the cause of soil conservation.

Dr. Bennett was born in North Carolina, owns a farm there today. He was graduated from the University in 1903, and shortly thereafter became a soil scientist in the Bureau of Soils. He served as a lieutenant in an engineering regiment during the World War.

Various important Government commissions carried him to the Canal Zone, Alaska, Honduras, Guatemala, Ecuador, Mexico, and Cuba.

His writings have ranged through popular magazine articles, reports, scientific papers, and textbooks. Among the familiar titles are *Soil Erosion a National Menace*, *The Soils of the United States*, *The Soils of Cuba*, *Possibilities for Para Rubber Production in Northern Tropical America*, and *Soils and Agriculture of the Southern States*.

It was in 1933 that Dr. Bennett was appointed to organize and direct a National program of erosion control under the Department of the Interior—a program which, under his able leadership, rapidly developed to the stature of the present Soil Conservation Service of the Department of Agriculture.

Sheet erosion in New Jersey coastal plain spinach field. Slope, about 2 percent.

CONTROLLING EROSION ON THE COASTAL PLAINS

By Alice Nichols

With a 1 percent limit on an A slope and serious erosion conditions to be found on fields with no more than a 3-percent gradient, the eastern coastal plain is offering some brand new problems in soil conservation. New Jersey's two new coastal plains projects are finding that measures which are effective elsewhere are often less so here, and that still other practices will not fit into the farming of the section.

Factors Peculiar to Area

Here are some of the factors which complicate the problem of erosion control:

1. High erosibility of soils—light loams and sandy loams.

2. Suitability of land to fruitgrowing and vegetable farming, forms of agriculture which leave the surface exposed during much of the year.

3. High production necessitated by high crop investments and high land values.

4. Impracticality of soil-binding through crop rotations, strip cropping and other methods practiced in general farming sections.

5. Lack of precedent for meeting existent conditions, since these are the first projects under way on the coastal plain.

6. A general belief that the erosion problem cannot be serious on these relatively flat lands.

New Devices

It looks as if some new techniques and new conservation terms are going to come out of New Jersey. Findings which are made there should have a wide application not only in New Jersey but also in coastal plains states to the south—Maryland, Delaware, Virginia, and the Carolinas—where similar erosion conditions and farming types exist.

Take the matter of controlling erosion in coastal plains orchards, where some of the most serious top soil losses occur. As a water conservation measure, fruit growers generally make a practice of clean cultivation. Though summer ground cover is increasing in favor—particularly in apple orchards where alternate middles are left in vegetation—many growers are more intent on immediate water

Strawberry plants silted over on 5 percent slope in southern New Jersey.

needs than on future soil needs. Most peach growers figure that vegetation would take too much water.

Mulch is one of the answers of the Soil Conservation Service, and its use has been written into several cooperative agreements. Mulches keep down weeds and thus do away with the need for cultivating. They give some protection, too, against the gullying which often starts from cuts made by the wheels of sprayers.

The erosion problem on the coastal plains was greatly augmented by the coming of the automobile. A number of years ago manure scows from New York City and Philadelphia supplied New Jersey farms with an abundance of cheap organic matter. This served to bind the sandy soils as well as to make them more absorptive. Though the use of winter cover crops, plowed under as green manures, is practiced extensively, the humus content of the coastal plain soils has been on the decrease, and high yields have been maintained only through use of increasing amounts of commercial fertilizer.

Adding Substance

Making the soil more absorptive and less erosible through adding organic matter, then, is one of the major soil conservation problems. This cannot be done through crop rotations because small grains and hay simply do not go with vegetable farming. This fact also makes ordinary strip cropping out of the question.

A practice which is taking hold, however, opens up possibilities for obtaining the beneficial effects which come from crop rotation and stripping. Some of the leading potato and vegetable growers are finding that they can well afford to give their land a periodic rest. In talking among themselves, some of the Soil Conservation Service men are calling this "alternation", and they are asking if it would not be feasible for growers to strip their cash crops with the land resting under cover.

Markets Govern

Fences are not used on vegetable farms, and acreages to be devoted to the various crops are determined by market prospects. Permanent buffer strips cannot easily be worked into this sort of a program because different crops require different spacing. This gives rise to the possibility of "shifting buffer strips" which would be left standing when the winter cover is plowed under.

No one measure will hold these sandy soils under the exposed types of farming they support. Considerable washing has been seen on cross-slope plantings and there is an alfalfa field on one general farm which has some gullying in it. Diversion terraces might have prevented these instances of erosion but their existence does show the need of applying every possible soil-conservation measure to every coastal plain farm.

THE PLACE OF THE FORESTER IN SOIL CONSERVATION

(Continued from p. 10)

his lumber, his posts, and his fuel, but he has become so accustomed to this that he has scarcely appreciated it. He has been more or less taking for granted what he gets from his woods, like the sunshine and rain. He has always had it, but has given it no attention and no credit. The burden of the soil conservation teaching is to get the farmer to see that he gets out of his farm very much in proportion to what he puts in. The farmer is, in this respect, in no different position than is the rest of the world. The woods on his farm is no exception to this universal rule. The forester's job is to show the farmer what to put into his woods and how to handle it in order to get the most out.

Appreciation of the Woods

First of all, then, the forester must be a crusader. He must make the farmer appreciate his woods so that he will keep it and take care of it. Chasing the woods about the farm is a poor way to get an income from it. He must appeal on the basis of economics, aesthetics, or sentiment, and after all, there is a lot of aesthetics and sentiment in both the woods and the farm. Dogwoods and redbud, June berry and laurel and rhododendron have their appeal, and so do 'coons and rabbits and quail and song birds; the pond down in the pasture, the old swimming hole, the mulberry tree, the papaws, persimmons and nut trees, are some of the things which make the old farm stand out not merely as a place of business and hard work, but as a home—there is sentiment as well as economics involved. The forester must make the farmer appreciate his woods by making them appear as they actually are, an integral and valuable part of the farm; capable of producing saleable products and as much in need of a definite plan of management as the cultivated crop portions of the farm. If he can succeed in doing this, the woods, which is the best agency to hold the soil, will not be destroyed by fire and grazing, or ruined by unintelligent cutting. The forester's job in soil conservation is definite and clear-cut. He not only has a place in soil conservation, he is indispensable.

CONTROL MEASURES MEET CHALLENGE OF HEAVY RAINS

(Continued from p. 7)

sponsored by the Service. A few of their notations, selected at random from the collection, are cited herewith.

Hereford, Texas.—Pasture contour-furrowed; 2 rows listed and 4 rows undisturbed. Penetration after 5.5-inch rainfall, 32 inches on furrowed pasture, 18 inches on unfurrowed adjoining pasture.

Memphis, Texas.—Sandy loam soil on farm cultivated and planted on contour, and terraced, wet past depth of 11 feet after approximately 6 inches of rain. On adjacent land, unterraced and farmed in straight rows, moisture to depth of only 7.5 feet.

Perryton, Texas.—Terraced loam soil has average moisture to depth of 32 inches while flat-cultivated land without terraces or contours has moisture to depth of but 21 inches, after 4 inches of rain in 10 days. On contour-furrowed pasture average moisture penetration 24 inches, as against 16 inches on untreated adjoining pastures.

Channing, Texas.—On land of 5-percent slope, terraced and contour-listed, moisture to depth of 52 inches, as compared with 28 inches on adjoining similar land not farmed on contour.

Clayton, New Mexico.—Following slow-falling rains totaling 1.6 inches during May, terraced and plowed field had moisture to depth of 27 inches, as contrasted to 15 inches on adjoining untreated fields.

Stratford, Texas.—Fine sandy loam, terraced, row-crop field receiving 5.31 inches of rain in 10 days showed moisture penetration to average depth of 5.5 feet. Similar adjoining land farmed in straight rows was wet to depth of 3.8 feet.

Springfield, Colo.—Rainfall 4.58 inches during May. Average moisture penetration, contour-listed land, 44 inches; land listed in straight rows, 35 inches.

Liberal, Kans.—Average moisture penetration on contour-furrowed pasture 45 inches, as compared with 17 inches on untreated pastures.

Vega, Texas.—Average depth of soil-moisture penetration on contour-listed land on S. C. S. project 2.15 feet following rains of 5.48 inches during last 10 days of May. On similar fields farmed in straight rows moisture penetrated to depth of 1.48 feet.

SWEET CLOVER ON THE BEAVER CREEK WATERSHED

By F. L. Higgins [1]

Sweet clover, only a few years ago considered a noxious weed, now occupies a high place among legumes for pasture and soil improvement. It starts growing early in the spring and produces a luxuriant verdure which provides excellent pasture for livestock. When plowed under for green manure, the roots and tops rot rapidly and crop yields respond.

On cooperating farms in the Beaver Creek watershed, near Caledonia, Minnesota, sweet clover plays an important role in contour strip cropping. It is especially well adapted to a two-year rotation, as follows: first year, grain with sweet clover; second year, corn. In this rotation, the sweet clover is seeded with the grain in the spring, and is left to make its growth in the fall after the grain is harvested and also during the following spring until about the first of May. The crop is then plowed under for corn. The strip that was in corn the previous year is thereupon seeded to grain and sweet clover.

The adjoining strip, which was seeded to grain and sweet clover the previous spring, has the sweet clover growth as a check on erosion until the strip which is being seeded to grain attains sufficient growth to bind the soil. This sweet clover is plowed under and the soil is prepared for corn. It is not advisable to plow under first-year sweet clover in the fall because of the likelihood of its coming up in the following crop. The rotation is illustrated below:

Strip 1—1937 in corn—1938 in grain and sweet clover seeded in April.

Strip 2—1937 in grain and sweet clover—1938 in sweet clover plowed May 1 for corn.

Turning under sweet clover as green manure every year will materially increase crop yields, and the humus supply of the soil will be maintained. This large amount of humus increases the capacity of the soil to hold and absorb rain water for crop growth. Rotations of corn and grain with sweet clover are now coming into general use, and corn yield has increased from 10 to 30 bushels per acre as a result. It should be pointed out, however, that since one of the crops is clean tilled, this rotation should not be practiced on excessively steep slopes.

High yields per acre mean profit per acre. For example, if it requires 25 bushels of corn to equal the

Sweet clover on farm near Greer, S. C. In this section it is a new crop, introduced by Soil Conservation Service. This stand was later plowed under and planted to corn.

[1] The author is assistant soil conservationist, Beaver Creek demonstration area, Caledonia, Minnesota.

cost of production, and if the soil is run down and can produce only that much, the farmer barely breaks even. If, on the other hand, he builds up his soil to a point where it will produce 60 bushels per acre, there will be a clear profit of 35 bushels with the same amount of work, provided there is no cost involved in building up the soil.

In a hilly country such as Southeastern Minnesota, there are many slopes of a gradient of from 15 to 25 percent which should never be in cultivated crops. The Soil Conservation Service recommends that these be devoted to hay or pasture. In strip cropping there are also some irregularly shaped pieces best adapted to alfalfa. Usually there is enough alfalfa produced on these steep slopes and odd pieces that the farmer does not need to grow hay on his strips. Under these conditions he cannot use the common 3-year rotation of corn-grain-sweet clover.

Experiments conducted at Kansas experiment stations show that the plowing under of six inches of sweet clover is equivalent to an application of 15 tons of manure per acre. The following tables show the fertility value of sweet clover, with amounts of nitrogen present in roots and tops one season after seeding, and total green weights per acre of tops and roots.

TABLE 1.—*Nitrogen present—pounds per acre*

Time of year	Top	Roots
April 10	15	162
April 25	63	103
May 15	128	75

TABLE 2.—*Total pounds per acre—green weight*

Time of year	Top	Roots
April 10	430	3,600
April 25	1,510	2,300
May 13	4,210	2,030

Table 1 shows that practically the same amount of nitrogen is present in the crop on April 10 as on April 25 and May 15. The food reserves are stored in the large tap root system in the fall. In the spring the early top growth is fed from these food reserves in the roots and there is simply a transfer of the nitrogen from the roots to the top. On the later dates, the data shows an increase of the nitrogen and total green weight in the tops and a corresponding decrease in the nitrogen and total green weight of the roots. Another point in favor of plowing under the crop at an earlier date is that, to produce this top growth, an equivalent of 10 inches of rainfall is required.

Before seeding sweet clover, the soil should be tested for acidity, and if necessary, lime should be applied. In the Beaver Creek watershed, most of the land requires an application of from 1½ to 2½ tons per acre. Sweet clover seed should be inoculated and seeded at the rate of 15 pounds per acre. Alfalfa requires the same amount of seed per acre. A firm seedbed is essential for a good stand, and a corrugated cultipacker can very often be used to good advantage in making the soil more compact both before and after seeding. These operations should be performed on the contour.

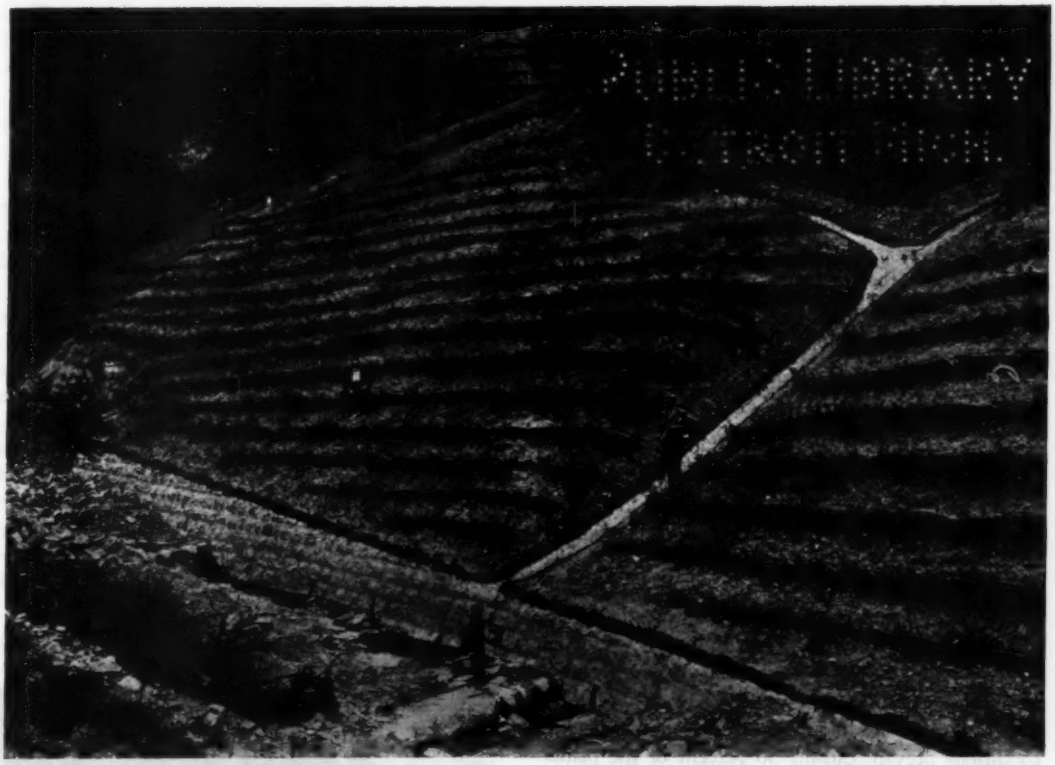
Sweet clover can also be used to great advantage in the rejuvenation of permanent pastures which have become low-yielding through thinning of the stand, poor soil, weed infestation, or acid condition of the soil. A large number of pastures at the present time are not as productive as they should be. They can be greatly improved by liming and fertilizing the soil and the seeding of sweet clover, not only from the standpoint of furnishing pasture, but also as a repellent to the white grubs of the June bug.

Pasture Demonstrations

In the soil-conservation program, it is planned to set up a number of demonstrations of permanent pasture improvements by liming the soil and thickening the pasture stand through the seeding of sweet clover. In some cases the old sod will be disked or spring-toothed, lime added, and sweet clover added at the rate of 10 pounds per acre. In other cases, instead of seeding sweet clover alone, a pasture mixture will be seeded consisting of 4 pounds of sweet clover, 4 pounds of alfalfa, 4 pounds of bluegrass, 2 pounds of brome, 2 pounds of red top, 2 pounds of alsike, and 2 pounds of timothy.

The introduction of alfalfa and sweet clover also helps in the control of the white grub which does so much damage to bluegrass pastures. For some reason, the June beetles do not like to lay their eggs where alfalfa and sweet clover are present. Recent experiments by the Wisconsin experiment station, have shown practically complete control of white grubs by seeding alfalfa and sweet clover in the pasture.

As a hay crop, sweet clover is not so good as alfalfa or red clover and is seldom used for hay in regions where alfalfa and red clover can be grown.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Slope of Italian brook regulated in 1932.

NOTES ON EROSION WORK IN FAR-AWAY ITALY

By Albert Chiera[1]

Erosion authorities in Italy, as elsewhere, are agreed as to the importance of vegetative cover. Notes which I have made in connection with my translations of Italian works, may prove of interest to readers of SOIL CONSERVATION.

In A. Serpieri's book the laws on integral land reclamation may be summed up as follows:

(1) By land conservation is meant the prevention of land destruction by carelesness on the part of landowners, or by improper methods of land exploitation, which, under penalty of law, the State will not tolerate.

(2) By land reclamation is meant those supplementary works required for restorative vegetation to become reestablished over denuded areas, particularly mountain slopes.

[1] The author is translator and research assistant, Soil Conservation Service.

Conservation works required to preserve the land in Italy must be carried out by landowners at their own expense; reclamation works, being more costly, are subsidized by the State, in some cases to the extent of 90 percent of the cost.

Let us now see how this work is carried out and the methods used.

Since Italy is a mountainous country, runoff waters mounting into torrents from the melting of snow and ice in the Alps and Apennines must be first be checked before any work of reforestation is attempted. Unfortunately, vegetation can only grow up to a certain altitude, and mountain torrents must first be controlled by large dams, which decrease in size as vegetation takes up its task of binding soil and restraining runoff waters.

Description of Dams

The steps that must be followed and the kind of dams best suited, according to the topography of the land, is intelligently described by C. Valentini in his book *Control of Torrents and Mountain Basins.*

On those slopes where vegetation is being assisted by supplementary small dams, denuded mountain slopes, broken up by gullies, are smoothed out. Supplementary works of fascines and wattles are then constructed on the contour of the slope, to stabilize it and to prevent drainage materials from rolling downhill before plants are sown or planted. In other cases large bench terraces (*gradoni*) are made to scale the mountain sides, and over these plants are sown or transplanted from the nurseries.

Ground Prepared for Vegetation

It might be of interest to note here, that according to E. Ferreri's *Woods and Pastures*, much of the failure of vegetation to grow on denuded slopes is due to failure to prepare the ground with temporary grasses which would have shielded the seeded plantlets from intense heat in summer and frost in winter. Another cause is found in the transplanting of young forest plants, grown more or less under ideal conditions in the nursery, to the mountain where severe climatic conditions prevail, causing 50 percent of the plants to die.

The author emphasizes and illustrates the necessity of growing plants in a nursery on a mountain resembling the climatic conditions of the place to which they are later to be transplanted, so that they may be well acclimated to resist the fury of the elements at high altitudes.

Regulating Streams

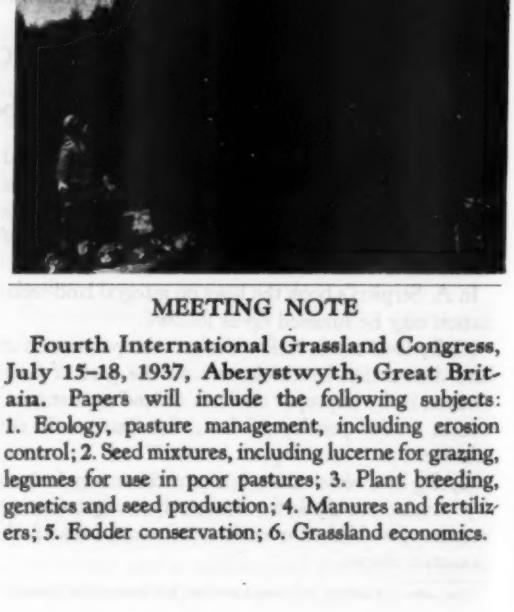
Once a forest is established and drainage of materials prevented, states C. Valentini, it is then possible to think of regulating streams and rivers.

A. Viappiani, in his book *Practical Fluvial Hydraulics*, emphasizes the importance of regulating the flow of a stream or river course. Here, also, crumbling must be prevented by smoothing out the banks, stabilizing them with grasses, shrubs, and trees, or protecting them by artificial means. Among the latter are repealing spurs, galvanized iron cages filled with stones, placed at strategic points, or the complete revetment of banks by stones; in short, artificial methods are many, all aiming to avoid depositation of eroded materials that either go to choke up the flow of a watercourse or raise its bed, either of which causes an overflow. In other cases, if the sediment is carried away, it may later deposit in reservoirs, resulting in silting.

In conclusion, the soil on the mountain, field, or banks of streams or rivers must be conserved by vegetation or assisted by inert materials if the land and water resources of the nation are to be preserved.

When this is not done, reclamation works must be undertaken at a much larger cost. Difficulties are then multiplied, ultimate success made dubious. How simpler it is, when possible, to prevent silting of a watercourse by binding the soil particles with vegetation than to sieve the water to remove them by all sorts of man-made contraptions! The building up of lowlands by sedimentation of waters charged with sediment is far more complicated than the preventing of destruction of good lands. This phase of the problem is very astutely discussed by A. Fanti in his book *The Technique and Practice of Reclamations.*

An example of Italian reforestation for flood and erosion control.



MEETING NOTE

Fourth International Grassland Congress, July 15–18, 1937, Aberystwyth, Great Britain. Papers will include the following subjects: 1. Ecology, pasture management, including erosion control; 2. Seed mixtures, including lucerne for grazing, legumes for use in poor pastures; 3. Plant breeding, genetics and seed production; 4. Manures and fertilizers; 5. Fodder conservation; 6. Grassland economics.

BOOK REVIEWS AND ABSTRACTS

By Phoebe O'Neall Faris

A contribution from the Soil Conservation Service Library

WEEDS. By W. C. Muenscher. 1935.

In cultivated lands weeds compete with crop plants for water, nutrients, and light. Furthermore, they are usually better adapted to obtain the larger share of whatever water is available as well as fertilizers supplied so that, unless they are destroyed, they soon outgrow the crops and shade them. Likewise, many common weeds act as hosts for fungi, bacteria, and mosaics, and insect pests which are transferred to crop plants. Examples are the common quack-grass (*Agropyron repens*) which harbors the black stem-rust of wheat, oats, and barley; and the burdock borer which infests corn-fields. In many places, such as arid regions where irrigation is practiced, weeds find favorable conditions for growth along the canals and laterals through which water is supplied to crops, thus interfering seriously with proper distribution of moisture.

On the other hand, those plants which are called weeds, when properly utilized, may prove beneficial. When plowed under or returned to the soil in some other way, weeds add humus and nutrients by returning to the soil nitrogen and ash constituents. In regions where soil blowing is common, or on sloping soils with sudden heavy downpours, weeds often form useful cover. Some weeds furnish forage for animals when more palatable plants are scarce; and millions of birds subsist on seeds which cling to weed stocks throughout winter months. The sour dock, lambs-quarter, milkweed, and several other common weeds are edible by humans; and there exists, too, a long list of common weeds that have medicinal properties and are used in the preparation of medicines and drugs.

With the knowledge that some weeds are harmful while others are beneficial, depending to some extent upon environment, it becomes obvious that information concerning the identification and control of weeds is important to the soil conservationist as well as to the farmer.

Part I of this book is devoted to a consideration of those characteristics and habits of weeds by which they affect other plants or interfere with man's activities, and also to the methods employed for their eradication or control. In the chapter bearing the title "Weeds of Special Habitats", weeds are classified according to persistent growth in lawns and turfs, pasture lands, hay fields, and meadows, cultivated fields and gardens, grain fields, cranberry bogs, and rice fields. These weeds of special habitats are the most troublesome and noxious of all, since their life cycles correspond so closely to those of the useful plants with which they grow and they tend to increased abundance and vigor as long as those crop plants are grown. The secret of the control of weeds of special crops is a system of rotation—change of habitat.

The control of a weed is a many-sided study. In the first place it is necessary to understand the habits, habitat, and distribution of the species, and secondly, to have knowledge of the various methods of weed-spread prevention, complete eradication, or control. The author discusses twenty-seven methods of weed control, and in addition, presents a complete chapter on the subject of control by chemicals.

Part II, comprising some 438 pages, forms a weed manual, with key to groups and species, and descriptions and data concerning names, duration, reproduction, dissemination, habitat, range, source, recognition, and control of the commonest weeds of the northern United States and Canada. Particular emphasis is given to identification and control.

In the manual the weeds are arranged in alphabetical order, under their scientific names, by families. The names used for species are those employed in botanical manuals and floras, and where there are differences in usage synonyms are included. The statements of distribution for the various species are not necessarily their botanical ranges, but the approximate area or areas in which they are known to occur as weeds.

The book contains 123 illustrations of weeds, most of which are drawings from live plants.

HUMUS: ORIGIN, CHEMICAL COMPOSITION, AND IMPORTANCE IN NATURE. By Selman A. Waksman. 1936.

In this, his latest work, the author who is professor of soil microbiology at Rutgers, and microbiologist, New Jersey Agricultural Experiment Station, tells the story of humus, its origin from plant and animal residues, its chemical composition, its physical properties, its importance in nature—especially in soil processes and in plant growth—and finally its decomposition. Humus is here treated as a natural body, produced universally in nature wherever plant or animal residues are undergoing decomposition; and here it is recognized that the primary agents in the formation and transformation of humus are the microorganisms.

In Part A of his book Professor Waksman treats of the chemical nature of humus, its formation, methods of determination in soils and in composts, and its role in plant nutrition.

Part B is an extensive thesis on the origin of humus, including a study of the isolation of chemical compounds of plant and animal residues and of the chemical nature of humus as a whole; of humus formation in composts and manures, in forest and heath soils, in mineral soils (field, grassland, garden, and orchard), in peat and in coal, and in rivers, lakes, and seas.

Part C deals with the decomposition of humus, involving the nature of the residues and the conditions under which decomposition takes place. In this section of his book, the author has included, along with the technical treatment of his subject much information of a practical nature. Herein is a discussion of specific substances in humus which are injurious or favorable to the growth of plants, animals, and microorganisms; a chapter on the agricultural utilization of humus; and, finally, a discussion of soil humus and the science of pedology.

The appendix contains outlines of five distinct methods for determining total humus in soils, peats, and composts.

Important data assembled in table form; 68-page bibliography; author and subject indexes.

APPLIED SILVICULTURE IN THE UNITED STATES. By R. H. Westveld. Ann Arbor. 1935.

Presents silvicultural methods applicable to timber stands that are managed primarily for the production of forest products. Gives a systematic study of climatic and physiographic features, forest vegetation, method of past treatment, natural and introduced animals, insects, diseases, and economic conditions of the following forest regions: Northwest spruce-hardwoods; New England white pine; oak; Allegheny hardwoods-pine-hemlock; Southern Appalachian; Southern pine; Central hardwoods; Lake States; Douglas fir; Northern Rocky Mountain; lodgepole pine; Southwest ponderosa pine; California pine; Northwest ponderosa pine; Black Hills ponderosa pine; Redwood; Southeastern Alaska.

References at ends of chapters. Appendix contains names of trees and their scientific equivalents. Map of forest regions of the United States. 86 photographs. Index.

PUBLIC LAND SURVEYS; HISTORY, INSTRUCTIONS, METHODS. By Lowell O. Stewart. Ames. 1935.

Traces the development of technical aspects of public land surveys. Gives instructions and field technique in the RectangularSystem of Surveying. Bibliography. Index.

BOOK REVIEWS AND ABSTRACTS

By Phoebe O'Neall Faris

A contribution from the Soil Conservation Service Library

WEED SEEDS. By Emil Korsmo. Oslo. 1935.

Professor Korsmo's manual of weed seeds is presented in three languages—Norwegian, German, and English. It includes descriptions of seeds and infructescence of 306 different species of weeds, all of which are shown in plates, with special care as to accuracy of color and size. The species are chiefly those to be found in Europe and North America. The book was compiled specifically as a guide for those directly concerned with the inspection of agricultural seed materials and includes, therefore, a selection of seeds from those species of weeds which are frequently found as impurities in seed materials. For example, seeds of *Plantago aristata* are present in clover and grass grown in North America; and *Bifora radians* commonly is to be found in Hungarian vetches. The collection is thus made useful in the identification of species which may be spread through the sale of seeds of various grains, grasses, and legumes.

In the descriptions of the seeds an attempt has been made to give figures for weights, in grams, of 1,000 seeds, and the greatest length and width of seeds in millimeters. A system of plate letter-reference is used, thus simplifying use of both plates and text. Distribution notations are given for all species.

At the end of the book is to be found an index of all included species of weeds, arranged alphabetically according to their latin names with an addition of the common names, in eleven different languages, i. e., American, Danish, English, French, Dutch, Italian, Canadian, Norwegian, Russian, Swedish, and German.

DESIGN OF CONCRETE STRUCTURES. By Leonard C. Urquhart and Charles E. O'Rourke. 1935.

In this revision most of the material has been rewritten to include the latest and best practice in plain and reinforced concrete design. Modern methods of design and control of concrete mixtures are described in detail. Contains chapters on plain concrete; general properties of reinforced concrete; beams and slabs; columns; bending and axial stress; stresses in continuous beams and building frames; foundations; reinforced concrete buildings; retaining walls; arches; slab, beam, and girder bridges.

THE TRANSLOCATION OF SOLUTES IN PLANTS. By Prof. Otis F. Curtis. New York and London. 1935.

A monograph for the plant physiologist, including a discussion of the historical side of the subject of translocation in plants. Contains the author's views on the particular functions of the different channels of transport in higher plants, and a survey of the investigations of Mason and Maskell on translocation in the cotton plant. Diagrams.

AMERICAN PLANNING AND CIVIC ANNUAL. Edited by Harlean James. American Planning and Civic Association. 1935. 356 pages.

The orderly development of a plan for common good makes a great and inspiring subject. This compilation contains articles by 81 authors and covers practically every phase of the national program for conservation. The Secretary of Agriculture, writing on rural-land problems, stresses the need for a permanent land-settlement policy in order to get a million farm families off the relief rolls. In Mr. Wallace's opinion this policy will involve land- and water-use laws; crop-control regulations; and the cooperation of farmer, grazer, forester, lumberman, wild-life conservationist, flood-control specialist, engineer, and land-retirement agency, for soil conservation.

In a brief résumé of soil conservation projects H. H. Bennett gives arresting figures on erosion damage in the United States gleaned from surveys made by his Service.

In the book are some specially fine monographs on the protection of wildlife. One, by Dr. Darling, former Chief of the Biological Survey, stresses most forcefully the one great need for animal and bird life, land where these creatures may have their home and preserve their species in proper habitat and interrelationships. Dr. Darling's famous cartoon is inserted, picturing a few hapless animals marooned by the gales of misfortune on a tiny island and staring with wild eyes into the tragic future. What person with imagination can study this cartoon without feeling a deep pity for the unfortunate wild creatures of our country? The pileated woodpecker, the grizzly, the wild turkey and the otter, the mountain goat and the wapiti—without national human planning for their preservation and their refuge, swift extinction will be the fate of these and many other species.

As set forth by the authors, the special function of national planning involves three types of service. The first of these is a cooperation of the multiplicity of ideas, activities, interests, needs, and specialties which the people of any community possess, apply, and press. A second necessary element is that of foreseeing the future as it links with the present and the past. The third factor—gathering data, studying, it and sorting out the good from the bad—is of the deepest importance to the methods of what we call planning.

In the third section of this annual there are several papers on the process of planning which are most enlightening to the layman. One concludes that a plan is as good as the directing intelligence under which it is made, and that the importance of the intelligence cannot be overweighed. The illustrations, 36 in all, serve to emphasize and clarify the subject matter. The book is well assembled, with the purposes of the American Planning and Civic Association clearly set forth on a page following the contents, an index, and a contributing-author column.

Having thoughtfully read this book, one cannot but appreciate to the uttermost the tragic danger in wasting something that is valuable to civilization—if for no other reason than that, in the far distant future, the students of antiquity may not malign our era.

(This book is available in our library for the usual short-period loans.)

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